Evaluation and Management of Dizziness after Head Trauma

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Why?

- AD population *in peacetime* 3X more likely to have TBI
- Balance disorders are present alone or in combination with other injuries in 65% of the injuries in Southwest Asia
- Over 70% of individuals involved in blast injuries have a resultant balance disorder

So what?

- Over 50% of balance disorders in the civilian population will resolve over time
- Less than 20% of war injured balance disorders will resolve without treatment

Untreated balance disorders

- Cost the military over $500 Million dollars a year in lost equipment and in lost mission accomplishment per year
- Result in medical discharges of valuable human resources (often at the peak of their military career)
- Cost billions of dollars a year in re-training and medical benefits
- Strain an already tight personnel pipeline
- Have dramatic effects on the lives of those who suffer from the balance disorder

Traumatic Brain Injury- Civilian Issues

- Second most common neurological disorder
- Incidence of over 500/100,000 individuals
- Costs the United States over $40 billion/year

Pathophysiology – Closed Head Injury (CHI)

- Consequences of head injury
  - Diffuse Axonal Injury (DAI)
  - Focal Edema
  - Release of excitatory neurotransmitters
  - Protenomics-early vascular proliferative phase

Resultant CNS effects – CHI

- Altered/disturbed message transfer along “balance pathway”
- Altered vestibular reflexes (VOR, VSR, etc.)
- Apoptotic cell death (continuing long after injury)

Pathophysiology – Blast Injury

- Shock wave effect
  - Sheer injury in vestibular end organ
  - Oxidative cellular stress
  - Release of excitatory neurotransmitters
  - Direct stimulation of apoptotic pathways

Resultant CNS effect – Blast Injury

- Targeted injury pattern - but may be multiple
- Peripheral end organ damage
- Hearing effects
- Particular pattern of cognitive difficulty

“Multi-systems” Trauma in war

- Body armor allows individuals to survive more significant impacts and injuries
- Associated injuries that effect balance
  - Orthopedic – legs
  - Spine injuries
  - Cognitive injuries

Classification

- Four Groups
  - Post-traumatic positional vertigo
  - Post-traumatic exertional dizziness
  - Post-traumatic migraine associated dizziness (PTMAD)
  - Post-traumatic spatial disorientation

Classes of TBI

- Mild – Mild Head injury, GCS 13-15, No or transient LOC (Subset of this group reported) Hoffer ME, Gottshall KR, Moore RJ, Balough BJ, Wester DC. *Characterizing and Treating Dizziness after Mild Head Trauma*. Otol/Neurotol, 25(2);135-38, 2004.
- Severe – Severe head injury, GCS <8 and/or need for ICP monitor, and or need for ventilator support due to head injury
- Moderate – Moderate head injury, GCS 9-13, and no need for ICP monitor or ventilator (due to head injury)

Materials and Methods

- Active duty military individuals with TBI
  - Combat
  - MVA
  - Altercation
  - Sporting event
- Exclusion criteria
  - Temporal bone fracture
  - Significant visual or proprioceptive damage
  - Seen in clinic more than 6 weeks post CHI

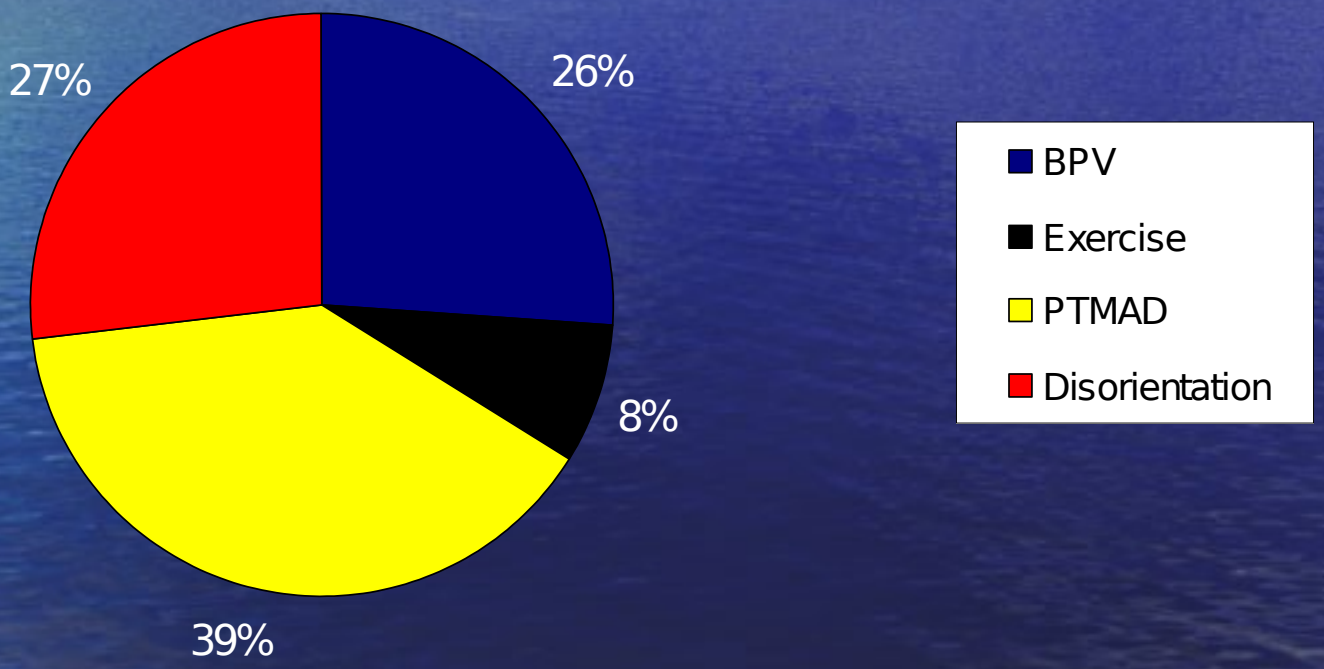
Patients

- >400 Total Patients
- Assigned by two independent investigators
  - Mild - 75%
  - Moderate – 13%
  - Severe –12%
  - Moderate and severe patient numbers limited by eligibility requirements for study

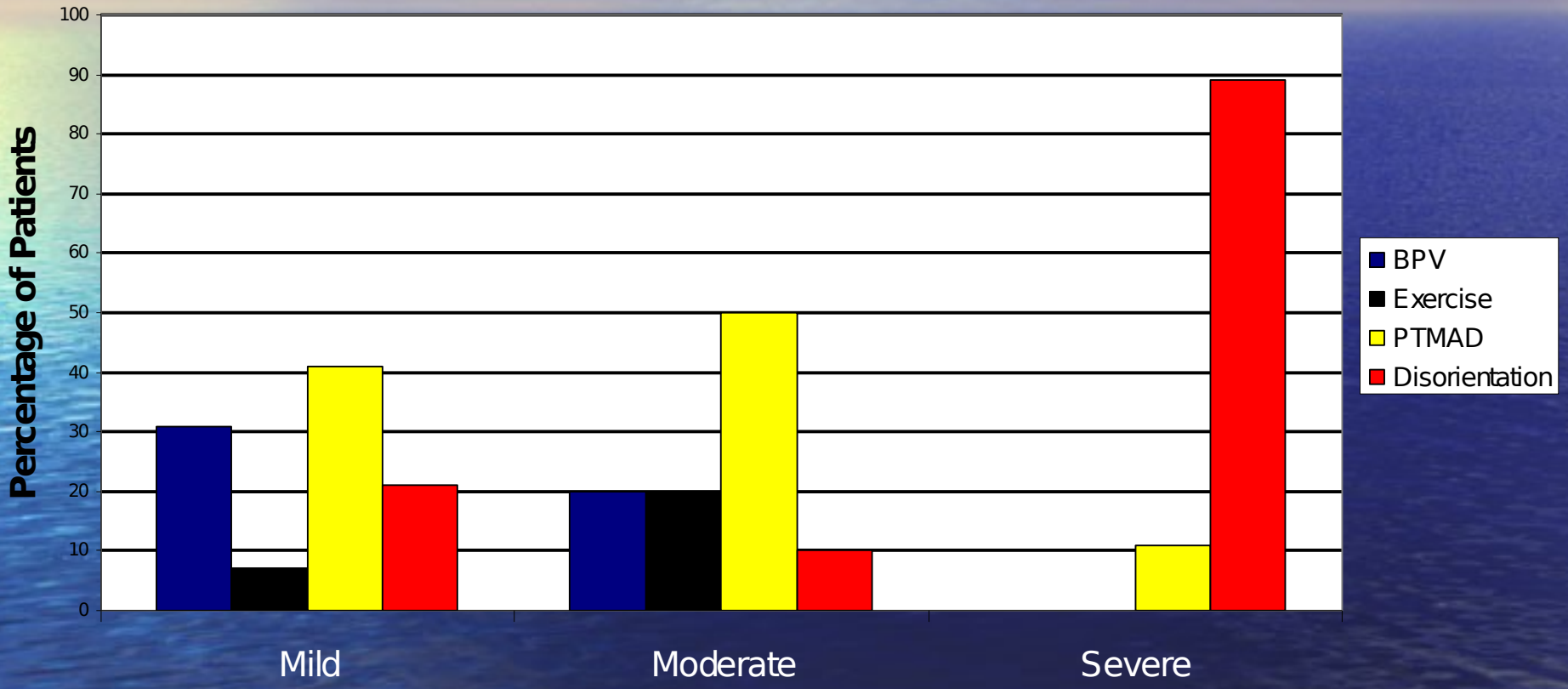
Classification of Dizziness after TBI

Entity	History	Physical Exam	Vestibular Tests
Positional Vertigo	Positional Vertigo	Nystagmus on Dix-Hallpike test or modified Dix-Hallpike test	No other abnormalities
Exertional Dizziness	Dizziness during and right after exercise	Abnormalities in challenged gait testing	No other abnormalities
Migraine Associated Dizziness	▪ Episodic Vertigo with periods of unsteadiness ▪ Headaches	▪ Abnormalities in challenged gait testing ▪ +/-Abnormalities on head impulse testing ▪ Normal static posture tests	▪ VOR gain, phase, or symmetry abnormalities ▪ High frequency VOR abnormalities ▪ Normal posturography
Spatial Disorientation	▪ Constant feeling of unsteadiness worsened by standing but still present when sitting or lying down ▪ Drifting to one side while walking ▪ Shifting weight	▪ Abnormalities on standard gait tests ▪ +/- Abnormalities on head impulse testing ▪ Abnormalities on static posture tests	▪ VOR gain, phase, or symmetry abnormalities ▪ High frequency VOR abnormalities ▪ Abnormal posturography ▪ Central findings on rotation chair testing

Distribution of Dizziness Types mTBI



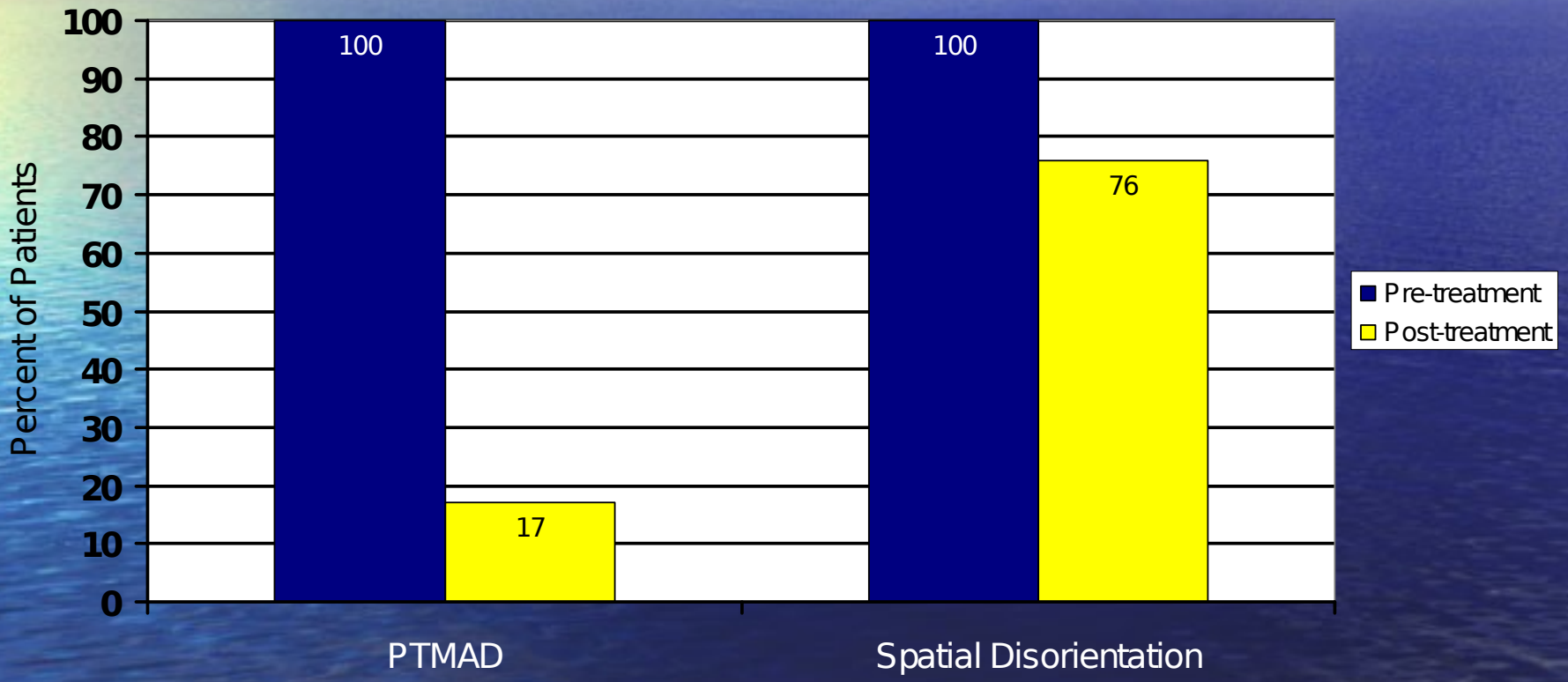
Dizziness Types



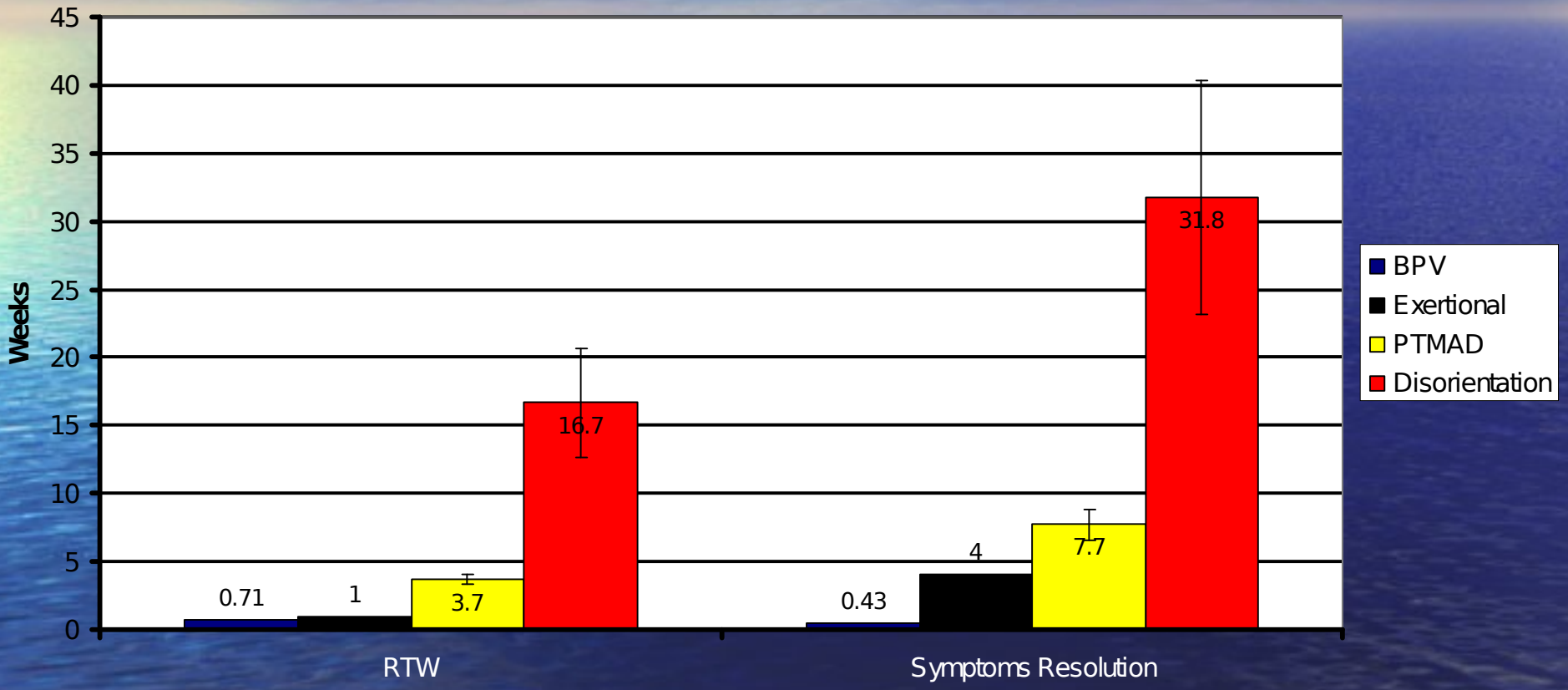
Outcome data

- All patients underwent vestibular rehabilitation – Details to follow
- All migraine patients received medicines
  - Migraine prophylactic medicine (Calan)
  - Migraine abortive medicine

VOR Abnormalities – 8 week follow-up



Functional Outcome-Return to Work



Findings

- Functional Outcome not dependent on injury severity
- Functional Outcome dependent on dizziness class
- More severe CHI does worse because more likely to be in “worse” dizziness class

Recovery Rates

- 73% of our patients (positional, exertional, and PTMAD groups) respond in 1-8 weeks indicating a possible positive effect of vestibular rehabilitation and active treatment in these three groups
- Over 85% of patients returned to full duty status (many have returned to Iraq)

Vestibular Rehabilitation

- Treatments that allow individuals to adapt to, compensate for, or respond to a balance disorder

Vestibular Rehabilitation

- Therapeutic exercises
- Therapeutic maneuvers
- Physical Conditioning
- Coping skills
- Devices

Sites at which to intervene

- Vestibular-ocular Reflex (Head and eye interaction)
- Vestibular-spinal Reflex (Head and spine interaction)
- Posture – spatial orientation sense
- Gait – with and without tasks
- General Conditioning – Getting in shape

Conclusion

- Post-traumatic dizziness is a significant military issue
- Emerging volume of documented, peer-reviewed work validating the impact of treatment
- We have moved forward on battlefield efforts to treat individuals earlier
- DoD/VA efforts in CONUS continue in creating dedicated centers